RDT

Brief

Research Investigation 90-019B

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BONDED PCCP OVERLAY
(Fast Track)
Route I-70, Cooper County

Research Development and Technology Division

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Project Description

Missouri's second bonded Portland cement concrete pavement (PCCP) overlay project was constructed on Route I-70, Cooper County during the summer of 1991 using a "fast track" high early strength (H.E.S.) paving mixture. The project is located on the westbound lanes of I-70 in Cooper County from the west end of the Lamine River bridge to 0.4 mile east of Route K. The project included extensive pavement repair to the original 8-inch reinforced PCC pavement, a 5-inch fast track bonded PCCP overlay, an approach slab, 268 feet of new 13-inch reinforced PCC pavement, and shoulder work. This brief covers the final summary report that focused on the investigation since the Construction and 90-Day Analysis report, published in 1995.

The major preconstruction distresses were joint faulting, and transverse and longitudinal cracking. Over 14 % of the original pavement within the overlay limits was replaced with new 8-inch PCC pavement repair or pavement replacement. This included 84 % of the contraction joints replaced.

The H.E.S. concrete bonded overlay was constructed with Type III cement to obtain a minimum compressive strength of 3500 psi in no more than 18 hours, as tested in the laboratory. The original pavement was prepared by coldmilling, shotblasting, and airblasting before overlaying. A neat grout, made of Type 1 cement and water, was sprayed directly on the pavement to enhance bonding. The same H.E.S. mix was also used to construct the 13-inch pavement replacement.

Observations and Conclusions

Cracks, approximately two per slab, were observed two days after placement of the first day's paving. The remaining concrete overlay was saw cut at 20 foot intervals to help control random cracking between the 61.5 foot standard contraction joints. At 90 days after construction, the driving lane averaged 5.1 cracks/slab and the passing lane average 4.4 cracks/slab.

Several problems arose during the paving of the overlay and 13-inch pavement replacement. The mixer unit had problems with buildup of hardened concrete in

the drum. Occasionally, a load of concrete was observed having pockets of raw unmixed material when it was unloaded on the pavement. Records indicate that these loads were promptly rejected and removed from the project. Within days, mud pockets and segregated concrete having a raw unmixed sand layer or a weak sandy layer was observed in the overlay after paving. Within 70 days after construction, the concrete overlay required 3747 sq.ft. of repair throughout the whole project due to the mud pockets and segregated concrete.

The overlay placed with the H.E.S. PCCP mixture was susceptible to a large temperature gradient during the curing phase. According to temperature data collected, the overlay had temperature gradient up to 16.9□F. This large temperature gradient exceeds the potential cracking temperature gradient of 7 to 10□F (Ref. 1). The temperature gradients were determined by calculating the difference of temperatures recorded from probes inserted at the surface compared tothe middepth or bottom locations in the overlay.

The difficulties encountered with the H.E.S. mix used on this project during construction and observations in pavement performance to date, indicate that the mix may be the source of some of the pavement distresses noted.

Since construction, the transverse cracking, longitudinal cracking and debonding in the concrete bonded overlay have continued to show a large increase of deterioration, especially at the locations of pavement repairs to the original pavement. A second noticeable deterioration is a map-cracking pattern throughout the project. A person must be within a few inches to actually see the entire map cracking and only the most severe map cracking amounts that could be seen while manually conducting the most recent survey were recorded. The map cracking is more pronounced around the original pavement repair areas and the more severe cracks. The map cracking and debonding is spreading further from the pavement repair areas.

The 13-inch full depth pavement and bridge approach slab are experiencing the same type of deterioration as the concrete bonded overlay. The full depth pavement and bridge approach slab were constructed using the same H.E.S., PCCP overlay mix design.

Recommendations:

The use of Type III cement in H.E.S. concrete should be used only where absolutely necessary. If using H.E.S. mix, strict quality control is recommended to prevent concrete mixture problems. Precautions should also be taken when placing and curing H.E.S. mixes to reduce large temperature gradients of the concrete during the curing process.

Further research should be pursued to closely investigate the concrete bonded overlay mix used on this project. A thorough evaluation, such as petrographic analysis or the use of a scanning electron microscope (SEM), should be considered.

The existing condition of potential candidate pavements for rehabilitation using the bonding PCCP overlay concept should be carefully evaluated for extent of existing deterioration. Pavements too distressed may lead to premature failure, as possibly demonstrated by the observed distresses in the I-70 PCCP overlay occurring at or near areas of pavement repair to the original pavement.